12 / PRTS

Watercraft

Technical Field

The invention relates to a watercraft as specified in the preamble of the first claim.

Prior Art

Four different types of mounting designs for the propeller drive used in watercraft are known. First there is the underwater transmission for an outboard motor; secondly, there is the so-called Z-drive; in addition, there is the shaft system; and finally, there is the waveguide system within a pipe, known as a jet, wherein the propeller functions as a so-called impeller. These mounting designs are employed for corresponding propeller-thrust purposes, such as, for example, full-immersion, partial-immersion or surface propulsion, or reaction propulsion.

The advantage of outboard motors and Z-drives is the fact that the underwater transmission, and thus the propeller, can be tilted backward and upward in the event the watercraft has entered shallow water, such that the propeller is prevented from striking the bottom and thus protected from being damaged. In addition, it is thus easy to replace a damaged propeller in the event there has been contact with the bottom or there has been a collision with deadwood. In areas containing sea grass, it is possible to raise the underwater transmission and to easily remove the long grass from the propeller blades and hub section.

Another advantage is the ability to transport and store the watercraft having these underwater transmissions since these units do not protrude beyond the bottom of the boat once the underwater transmission has been swung upwards.

The disadvantage, however, is the large space requirement within the stern region for the raised underwater transmission and propeller, as well as the fact of the outboard motor's tilting into the cockpit area of the watercraft. In addition, it is almost impossible for the person steering the watercraft to continuously monitor both the water surface and underwater topography during planing so as to be able to raise the underwater transmission quickly enough in the event an underwater obstacle is located in the path of the craft. As a result, the propeller and transmission may be damaged and the propeller need to be replaced – with the resulting costs incurred. In addition, when the underwater transmission is tilted upward, the propeller thrust angle is directed downward, with the result that the stern of the craft can be pulled downward if the power lever was not released immediately; or the bow nose can rise suddenly, thereby obscuring forward vision and increasing the risk of accident.

Description of the Invention

The goal of the invention is to avoid the above-described disadvantages in a watercraft of prior art, and to provide a system for watercraft which has a small space requirement at the stern of the watercraft, while additionally enabling the watercraft be to utilized in various ways, such as, for example, providing a high startup thrust for water-skiing, little resistance at high speeds, and no projecting drive components in situations of shallow waters.

According to the invention, the above advantages are achieved by the features of the first claim.

The core idea of the invention is, in other words, that at least one section of the underwater transmission and the propeller are able to be pivoted by certain means laterally relative to the watercraft.

The advantages of the invention involve, among other things, the fact that a radially pivotable underwater transmission allows for a space-saving underwater transmission having an unmodified thrust direction for the propeller in any pivot position. As a result, the underwater transmission may be pivoted laterally when shallows are encountered up to the point that this unit reaches the level of a separate water intake opening.
The water for the propeller thrust is thus no longer taken in below the hull of the watercraft, and the craft's travel may be continued in shallow locations which would otherwise be impassable for standard outboard Z-driven or shaft-driven watercraft.
The water intake has advantages and power output similar to that of a jet drive. Another advantage consists in the fact that the propeller can be protected from grounding, while at the same time sea grass is still able to be easily removed from the open propeller region – for example, by additional lateral upward pivoting of the underwater transmission, even to the point that the underwater transmission emerges above the surface of the water.

The invention solves the problem of a large space requirement at the stern of the watercraft, or the undesirable necessity of having space available in an outboard-motor-craft's cockpit, as well as the problem of changes in the propeller thrust angle when the underwater transmission is raised. While Z-drives do not have the space problem in the cockpit, the factors of thrust angle change and the additional space requirement at the stern when the drive unit is swung upward remain. In addition, the invention solves the

problem of a rigid propeller position under the watercraft's bottom posed by shaft systems.

Furthermore, the invention ideally combines the advantages of propeller-driven thrust for a watercraft with the advantages, but not the disadvantages, of the jet drive in which thrust is generated by an impeller within a pipe.

The function whereby the underwater transmission can be pivoted through a large angular zone without loss of power permits the propeller also to be operated as a surface-propeller drive unit, that is, when underway the propeller is only partially submerged when used, and may be employed in high-speed watercraft.
For this purpose, a modified section is employed which is located above the waterline during planing, and to the end of which is attached the pivoting component for the underwater transmission.

In the pivoted-up position, the water intake or opening to the propeller may be either open or closed, that is, appropriate flap valves cover the water inlet when not in use; or such flaps are not even present, but instead a cutout is located in the hull of the watercraft providing a suitable means of flow to the propeller. The water intake opening may be located on the lateral side or within the bottom region of the watercraft, as governed by the power input of the drive unit.

In the case of outboard systems, the pivot mechanism may be at the level of the motor – with the advantage that the motor does not have to be installed vertically; instead the drive shaft output may be oriented horizontally as in an automobile. This pivot design is suitable both for implementations with Z-drives as well as when using shaft systems.

For existing outboard systems, a pivot drive is especially well suited which is located under the motor and is thus of a very short design. Since the motor output shaft on commercially available outboard motors is vertical, a bevel gear pair or similar power-diversion mechanism / right-angle drive is inserted so as to ensure the pivot motion of the underwater transmission. The pivoting actuator may be a gear drive or pivoting lever which is actuated by a hydraulic or electrical servomotor, although in the case of smaller outboard systems this function may also be implemented purely mechanically.

Additional advantageous embodiment of the invention are presented in the description and subclaims.

Brief Description of the Drawings

The following discussion explains the embodiments of the invention in more detail based on the drawings. Identical elements in the various figures are provided with identical reference notations. The direction of flow for media, or the direction of motion for elements is indicated by arrows.

Figure 1 is a plan view of the watercraft according to the invention;
Figure 2 is a plan view of the stern of the watercraft;
Figure 3 is a plan view of the stern of the watercraft in another embodiment;
Figure 4 is a plan view of the stern of the watercraft in another embodiment with a projecting stern transom;
Figure 5 shows the motor horizontally oriented with a variant of the underwater transmission;

Figure 6 shows the motor vertically oriented with the variant of the underwater transmission;
Figure 7 is a detailed view of the pivoting component with angular transmission from Figure 6;
Figure 8 is a schematic view of the pivoting component with angular transmission and second angular transmission;
Figure 9 shows an embodiment of the water intake in the bottom region of the watercraft as a longitudinal section;
Figure 10 as well as the related Figures 10A, 10B and 10C show various flap valve positions for the water intakes located laterally on the hull;
Figure 11A and the related Figure 11B shows the lateral pivot mechanism of the underwater transmission coupled to a steering wheel of the watercraft;
Figure 12A and the related 12B show the lateral pivot mechanism of the underwater transmission coupled to a steering wheel of the watercraft; transmission is pivoted together with the motor;
Figure 13A and the related 13B show a watercraft with an electronic or mechanical depth gauge directed forwards;
Figure 14A and the related 14B show rotatably mounted fins.

Only those elements essential to understanding the invention are shown. Not shown are, for example, additional elements of the watercraft such as the boat superstructure, etc.

Means of Implementing the Invention

Figure 1 illustrates a watercraft 1 according to the invention including a hull 2, underwater transmission 3, and a propeller 4 attached to this transmission. The motor located at the stern of watercraft 1 is not shown. The motor is linked to transmission 3 through a shaft,

also not shown, which transmission 3 is located in the stern side 5 of hull 2 and may have multiple shafts and bevel gear pairs. In Figure 1, an example of the operating position for propeller 4 is shown on the right side. On the left side, the propeller has been swung laterally upward such that the propeller comes to rest at least partially in the region of a water intake 6, including a water intake opening 7 and water outlet opening 8, located on or in boat hull 2. Pivoting of propeller can be triggered either manually or automatically by a specific event. The pilot may, for example, set various pivot positions as desired by a switch on the controls, or pivoting can be implemented by electronic controls which respond to different parameters, for example, the water depth, speed of the motor, etc.

The water intake 6 to provide the appropriate flow to the propeller may be located on the lateral side of the boat in the form of a closed channel in the hull, as illustrated on the right in Figure 1, or as a cut-out section, as shown on the left in Figure 1, which is located in the hull of the watercraft in order to provide the appropriate flow to the propeller. Water intake 6, or water intake opening 8, may be either open of closed, that is, appropriate flap valves cover the water inlet opening when not in use, or such flap valves are not present at all, as is the case for the cut-out section in the hull of the watercraft, shown on the left in Figure 1.

Use of the radially pivotable underwater transmission 3, and thus propeller 4, provides for a space-saving underwater transmission having an unchanged thrust direction for the propeller in any pivot position. Thus, in the case of shallow water, underwater transmission 3 may be pivoted laterally until it reaches the level of water intake 6. The water required for propeller thrust is thus no longer taken in below the hull of the watercraft, but instead essentially behind and protected by stern side 5 of watercraft 1, such that travel may be continued despite the condition of shallow water.

The water intake thus has advantages and power output analogous to that of a jet drive system. An additional advantage is the fact that the propeller is protected from striking the bottom, while also allowing sea grass to be easily removed from the open propeller region – for example, by laterally moving the underwater transmission further upward until underwater transmission 3 and propeller 4 actually emerge above the surface of the water.

Underwater transmission 3 together with the propeller may additionally be designed to pivot longitudinally, that is, in the longitudinal direction of the watercraft's axis. This longitudinal pivoting by a few degrees of angle, also known as trimming, helps keep the bow of the watercraft steady in rough water, or to make it faster.

Figure 2 essentially repeats the illustration of the stern of the watercraft as seen in Figure 1. What is shown here, however, are only the water intakes 6 integrated in the hull and having closed channels which may be closed by flap valve 9. The function of this flap valve 9 is described in more detail below under Figure 10.

Figure 3 illustrates another embodiment of water intake 6 which is now situated in the bottom of the watercraft – an approach which may be advantageous depending on the power input of the drive unit. The transmission and propeller 4 are here pivoted laterally towards the center plane of the watercraft until the propeller comes to rest over water outlet opening 8, see right-hand side of Figure 3.
Here again, of course, the water intake shown as a closed channel within the hull can also be implemented as a cut-out section as illustrated on the left in Figure 1 in order to achieve the required flow to the propeller.

In Figure 4, the laterally pivotable underwater transmission 3 is located in a projecting, that is, back-set and self-supporting stern transom 10. Propeller 4 may then also be operated in a surface propeller drive mode, as shown in the broken-line position on the right-hand side of Figure 4, that is, when underway the propeller is operated only partially submerged – an approach employed in high-speed watercraft. For this purpose, an extended stern section 10 is attached which is situated above the waterline during planing, and to the end of which the pivoting component for the underwater transmission 3 is attached.

Also shown is a propeller shroud 11 which protects the user of the watercraft when the propeller is operated in the laterally pivoted position. This type of propeller shroud may, of course, also be employed in the embodiments shown in the other figures.

In addition, propeller 4 may be pivoted into a completely submerged position, as shown on the left-hand side of Figure 4. As a result, the propeller may be employed in a wide variety of positions, depending on the requirements of the watercraft operator. Similarly, the water intake may be located, as shown, towards the center of the boat.

Figures 5 and 6 illustrate different variants of underwater transmission 3, wherein a motor is designed either as in Figure 5 with a horizontal crankshaft or engine shaft, or as in Figure 6 with a vertical crankshaft or engine shaft. Motor 12 is connected to the boat by a motor bracket 13.

In the implementation of Figure 5 with horizontal motor 12, the lateral pivotability is generated by a pivoting component 14 and an angular transmission 15. In the implementation of Figure 6 with vertical motor 12, the lateral pivotability is generated by a pivoting component with an angular transmission 16 and a second angular transmission 17.

Figure 7 describes the pivoting component together with angular transmission 16 of Figure 6 in detail for a vertical crankshaft or motor shaft. Power from the motor is transmitted through a shaft 18 and an angular transmission 19 composed of two beveled bears to drive shaft 20 which then through, for example, additional shafts and right-angle drives ultimately drives the propeller. Right-angle drive 19 is located in a right-angle drive housing 21 which is permanently attached to the motor section. A bearing and pivot seating component 23 is flanged-mounted by flanges 22 to right-angle drive housing 21, and thus permanently attached to the right-angle drive housing. Arranged around bearing and pivot seating component 23 is a swivel component 24 which is pivotably mounted by axial and radial bearing 25 relative to bearing and pivot seating component 23. A Z-drive component 27, not shown here, is flange-mounted through flanges 26 to swivel component 24, in which Z-drive component the second angular transmission of Figure 6 is located. A beveled gear ring 28 is in turn attached to bearing and pivot seating component 28, which ring a gear ring 29 engages which is driven by a pivot motor 30 attached to swivel component 24. When pivot motor 30 is actuated, gear ring 29 rotates, engaging gear ring 28 on bearing and pivot seating component 23. As a result, swivel component 24 rotates which is rotatably mounted relative to bearing and pivot seating component 23. Depending on the direction of motion for pivot motor 30, swivel component 24, and the flange-mounted drive component thereon, are thus able to be moved and pivoted. Bearing and pivot seating component 23, and the swivel component, are sealed relative to each other by seals 31, however, additional seals not shown may also be provided.

With horizontally oriented motors, such as shown in Figure 5, as well as with Z-drives, shaft systems, etc., right-angle drive housing 21 is omitted, and bearing and pivot seating component 23 is thus attached directly to the motor housing, or holding frame, or stern platform.

With electrically or hydraulically driven propellers, drive shaft 20 is omitted; in their place, electrical or hydraulic lines are routed through bearing and pivot seating component 23 where the drive shaft is otherwise located.

Figure 8 is another schematic view of the pivoting component with angular transmission 16 and second angular transmission 17; here only the critical items will be described once again. Motor shaft 18 is driven by vertical motor 12, and the rotary motion is transmitted by right-angle drive 19 to horizontal drive shaft 20. This shaft is held by bearing and pivot seating component 23 and is enclosed by swivel component 24, located next to which are the drive component with second angular transmission 17, and a second right-angle drive 32 by which vertical drive shaft 33 to the propeller is driven. Here again, the swivel component 27 is pivotable by means of an additional device, not shown, by which vertical drive shaft 33 is then pivoted.

The pivoting actuator may be a gear drive or a pivot lever which is actuated by a hydraulic or electrical servomotor, although in the case of smaller outboard systems this function may also be implemented purely mechanically.

Figure 9 shows the embodiment of the water intake in the bottom region, already shown in Figure 3, as a longitudinal section. By means of the flap valve 9 located in the bottom region of hull 2, water intake 7 may be opened or closed, thus allowing water to flow through the enclosed channel 6, the water exiting from the water outlet opening. There the water on the outlet side strikes the appropriately pivoted propeller 4. A propeller shroud 11 may be optionally located around the propeller.

Figure 10 and the associated Figures 10A, 10B and 10C illustrate various flap valve positions for water intakes 6 located laterally on the hull, for example, as shown in Figures 1, 2, and 4. Figure 10 here shows various flap valve positions for flap valve 9 in one Figure.

These side-located flow-flap-vales 9 may be employed to further improve the flow to the propeller in the pivoted-up position. Flap valve 9, or a plurality thereof, may additionally serve to steer the watercraft when maneuvering in a harbor since the flap valves may be rotated at right angles to the hull, thereby achieving the effect of lateral / transverse thrusters. This configuration is achieved by the backwards thrust of the propeller, such that the motion of water mass generated by the propeller past the flow valve is diverted as an outflow at a right angle or appropriately adjusted angle relative to the watercraft hull, thereby generating a lateral thrust. In two-motor watercraft, particularly those with an adjustable propeller, it is possible to provide a highly precise, efficient and cost-effective maneuvering aid which is also advantageous in terms of protecting other watercraft in narrow harbors.

In Figure 10A, flap valve 9 for the water inlet to the water intake is open. Using propeller 4 pivoted in front of outlet opening 8, it is now possible to move the watercraft forwards or backwards, depending on the rotational direction of propeller 4.

In Figure 10B, flap valve 9 is completely open and in a transverse position, the flap valve being designed such that the water is expelled from the water intake opening transversely to the side of the boat. In this position, it is thus possible to use the water intake channel as a lateral / transverse thruster, thereby making maneuvering significantly easier, while rendering unnecessary separate lateral / transverse thrusters, with the resulting cost savings. In Figure 10C, flap valve 9 is completely closed, as a result of which water intake opening 7 is closed. The propeller is then pivoted away into the normal operating position such that it is again in the position shown, for example on the right-hand side of Figure 1.

As indicated in Figures 11A and 11B, using the example of an outboard motor 12, the lateral pivot mechanism of underwater transmission 3, and thus propeller 4, may additionally be coupled to the steering wheel 34 of the watercraft. When moving through tight curves – a maneuver that often results in the propeller emerging from the water and into the air, thereby causing thrust to break off completely – a steering movement on steering wheel 34 triggers an opposite pivoting motion of underwater transmission 3, thereby counteracting the tendency of the propeller to emerge.

As indicated in Figures 12A and 12B, motor 12 may also be pivoted together with underwater transmission 3. This provides for an especially cost-effective application of the pivot mechanism. For this purpose, a bogie is inserted during assembly of the outboard system on stern 5 of watercraft 1, thereby enabling motor 12 together with underwater transmission 3 to be laterally pivoted in both directions by a predetermined degree of angle relative to the longitudinal axis of the watercraft.

In Figures 13A and 13B, a watercraft is provided with a forwards directed electronic or mechanical depth gauge 35. When depth gauge 35 signals that a certain depth governed by the draft of watercraft 1 has been exceeded, and thus a collision risk exists for underwater transmission 3 or propeller 4 with an underwater object 36, a triggering means is activated so as to automatically rotate underwater transmission 3 by pivoting it out of the danger zone to the level of water intake 6, as illustrated on the left-hand side of Figure 13B. At the same time, the speed of motor 12 may be reduced to prevent a collision at high speed with possible hazardous object 36.

Figures 14A and 14B illustrate a rotatably mounted fin 37 which functions to protect the propeller from striking the bottom. Propeller 4 may be positioned in front of or behind the vertical drive shaft of underwater transmission 3. Particularly in the version in which propeller 4 is located in the direction of travel in front of underwater transmission 3, rotatably mounted fin 37, which is situated immediately in front of the propeller or underwater transmission, may be pivoted up, either simultaneously or delayed, into the interior of the watercraft's hull when underwater transmission 3 pivots, thereby keeping the entire watercraft bottom free from projecting objects while providing a greater draft for watercraft 1.

Fin 37 is rotatable about pivot bearing 38 relative to hull 2. A gear 40 may be actuated by a motor 39, which gear engages a gear 41 attached to fin 37[1]. The fin may thus be pivoted into a recess 42 in hull 2, then extended again when the propeller is swung down.

The pivoting of the safety fin may be effected hydraulically, electrically, or directly mechanically by a Bowden cable or similar means coupled to the pivoting of the propeller.

The fin may also be coupled to a trigger sensor, whereby making hard contact activates a command that the underwater transmission and propeller by quickly pivoted laterally.

It is of course understood that the invention is not limited to the embodiment illustrated and described here.

The position of the propeller on the watercraft may be chosen according to the latest technology. The term "Z-drive" refers not only to underwater transmissions in which the propeller is situated on the outflow side of the transmission, but also to those in which the propeller generates its thrust in front of the transmission.

[1] Translator's note: reference number corrected from context.

The underwater transmission is also not limited to the classic transmission structure, since either hydraulic or electrical lines may replace the gears and shafts within the underwater transmission, and the underwater transmission may have an electrical or hydraulic propulsion means on the propeller shaft.

In addition, longitudinal trimming of a watercraft, as employed in various Z-drives and outboard systems, continues to be provided by this invention.

List of reference notations

1	watercraft
2	hull
3	underwater transmission
4	propeller
5	stern side
6	water intake
7	water intake opening
8	water outlet opening
9	flap valve
10	stern transom
11	propeller shroud
12	motor
13	motor mount
14	pivoting component
15	angular transmission
16	pivoting component with angular transmission
17	second angular transmission
18	motor shaft

19	right-angle drive
20	drive shaft
21	right-angle drive housing
22	flange
23	bearing and pivot seating component
24	swivel component
25	axial and radial bearing
26	flange
27	drive component
28	gear ring
29	gear ring
30	pivot motor
31	seal
32	second right-angle drive
33	drive shaft
34	steering wheel
35	depth gauge
36	underwater object
37	fin
38	pivot bearing
39	motor
40	gear
41	fin gear
42	recess